STUDENT AWARDS

QPARK Quality in parking

SOLAR CHARGING ELECTRIC VEHICLES

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Analysing the charging efficacy of an off-grid, solar powered electric vehicle charging system in long-stay parking applications

This thesis analyses the efficacy of off-grid solar powered EV charging systems, specifically for long-stay car parking at airports. The aim of such EV charging systems is to ensure that the EV is sufficiently charged for the return journey when the owner returns to retrieve their car.

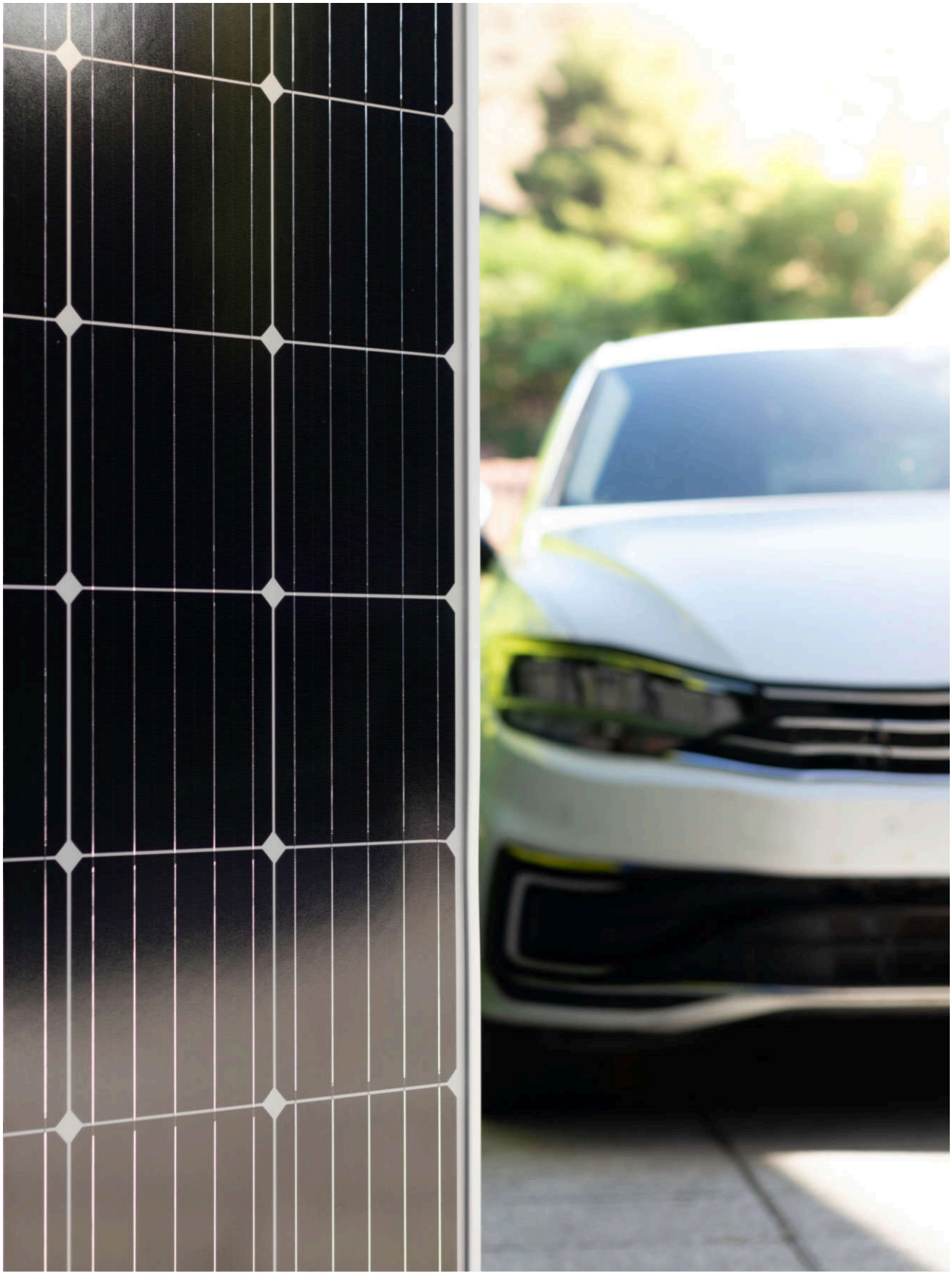
The research is based on a pilot study at Lelystad Airport long-stay car park. This facility includes 108 parking spaces for EVs under canopies fitted with solar panels. South-facing canopies covering four parking spaces, each with an EV charging point, are fitted with solar panels, 40 per canopy, 10 per parking space. Each parking space is equipped with a 3.7 kW charging point, which is powered only from the combined capacity of the solar panels. There is no top-up from the grid.

Arrival times were derived from information provided by Schiphol in November 2019, adjusted for the volume of the other months and assuming that flight arrival and departure times are comparable. The length of stay was derived from parking duration data provided by Boston Airport with a minimum of 48 hours, as the focus was on long-stay parking. The charging characteristics, including battery capacity and charging speed, of one of the ten most popular EVs sold in 2019 were then applied to each charging operation.

The simulations calculated that on departure, 85 percent of the cars would be sufficiently charged, in other words, with at least 75 percent of the battery capacity. Power generation was simulated based on weather conditions throughout the year: in the months April to August there was clearly overproduction. Throughout the winter months the charging efficacy dropped, to be expected for a location in the Netherlands at a latitude of 52°. In December and January, the simulation indicated that only 50 percent of the EVs leaving the car park had a sufficiently charged battery.

The underutilised generating capacity in the months April to August could be better used. A battery energy storage system is an obvious recommendation, and if sized and managed appropriately could offer reserve energy during the winter months and improve charging efficacy in the worst performing period.

Based on assumptions for installation costs and the price of electricity at € 0.36 per kWh, a payback period of 10 years was calculated. In the economic analysis, this basic case was compared with two alternatives: solar panels with top-up from the grid connection and powering the EV charging points only from the grid, without solar panels. The first alternative, solar panels with grid connection, requires the highest investment and has an estimated payback period of 15 years. The second alternative, where EV charging points powered from the grid without solar panels, has an estimated payback period of 9 years. However, there are disadvantages associated with the alternatives including grid connection, namely the capacity of the grid to incorporate new connections, and the associated risks regarding supply continuity.



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Q-Park has received several ESPA and EPA awards.

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